Space Weather Technical Forecast

Issued on Thursday, 18 November 2021 at 12:58 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Active electron fluence Likely into UTC weekend, Chance of G1 to end it.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the last 24 hours, with no significant X-ray flare activity observed at GOES 16, and with a slight decline in the observed background. There are two active sunspot regions on the visible disc: AR2896 and AR2897, which are both small and stable unipolar Hsx/Alpha regions located in the eastern hemisphere.

A possible filament became mobile at low solar latitudes near centre-disc around 17/2000UTC (seen in AIA 304 imagery). This event was not apparent in ground-based observatory H-Alpha imagery, and as yet this event has not manifested on coronagraphs. No Earth-directed Coronal Mass Ejections (CMEs) have been observed in available imagery.

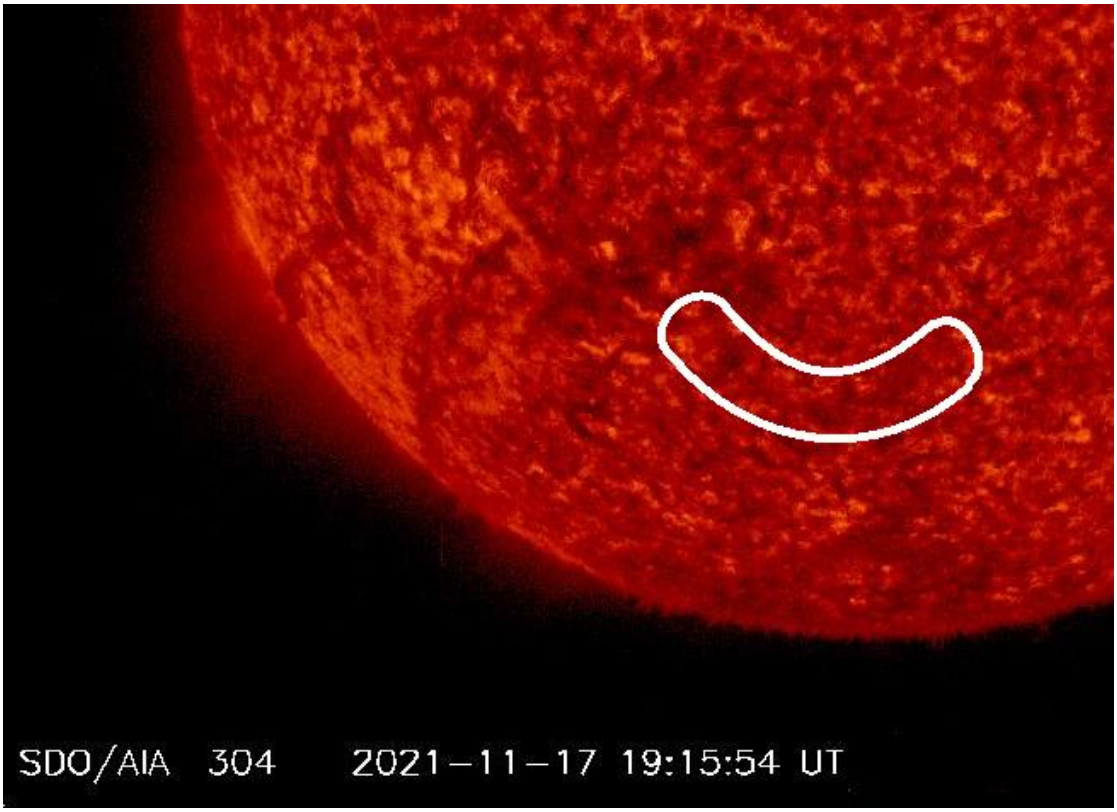

Figure 0: AIA304 imagery showing a mobile filament late in the UTC day of Wednesday 17 November. This event has yet to appear on any coronagraph imagery and may therefore have not left the immediate solar environment.

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Solar Wind / Geomagnetic Activity: The solar wind has been suggestive of a gradual exit from the high speed stream of coronal hole 19 in the period. The solar wind speed, as measured by DSCOVR and ACE at L1, gradually fell from early highs in the low-600s of km/s, reaching the low-500s by the period's end. The solar wind density remained within single figures ppcc throughout, while the IMF showed a stable trend with a peak of 5nT and a north-south component ranging between +4 and -3nT. The phi angle was negative (towards the sun) throughout the 24 hours.

The net result of the above solar wind measures was provisionally mainly Quiet Kp indices, but with an Unsettled peak of '3o' observed in the 21-24UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained at Background levels.

The high energy electron flux (greater than 2 MeV) was predominantly at Normal Background, but increased to Moderate levels in the diurnal UTC afternoon peak. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), but has started to gradually increase, reaching 6.56e6 integrated pfu at 18/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Very Low, with a daily Slight Chance of C-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs in the current forecast. The coronal hole forecast comprises of a continuing exit from the current CH19; and then the uncertain onset and intensity of subsequent CH20. On balance, geomagnetic activity from the current feature ought to have long peaked, and mainly Quiet geomagnetic activity is therefore expected into the UTC weekend. There is considered a Chance of G1 arising from CH20's effects, starting later on day three, Saturday 20 November and continuing on Sunday.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels.

The high energy electron flux (greater than 2 MeV) should show a reaction upwards to the waning current high speed stream from coronal hole 19, with Active fluence Likely from day two, Friday 19 November. Further apparent attenuation of electron counts is then likely for the second half of the UTC weekend, ahead of a probable return to Active fluence into the new working week.

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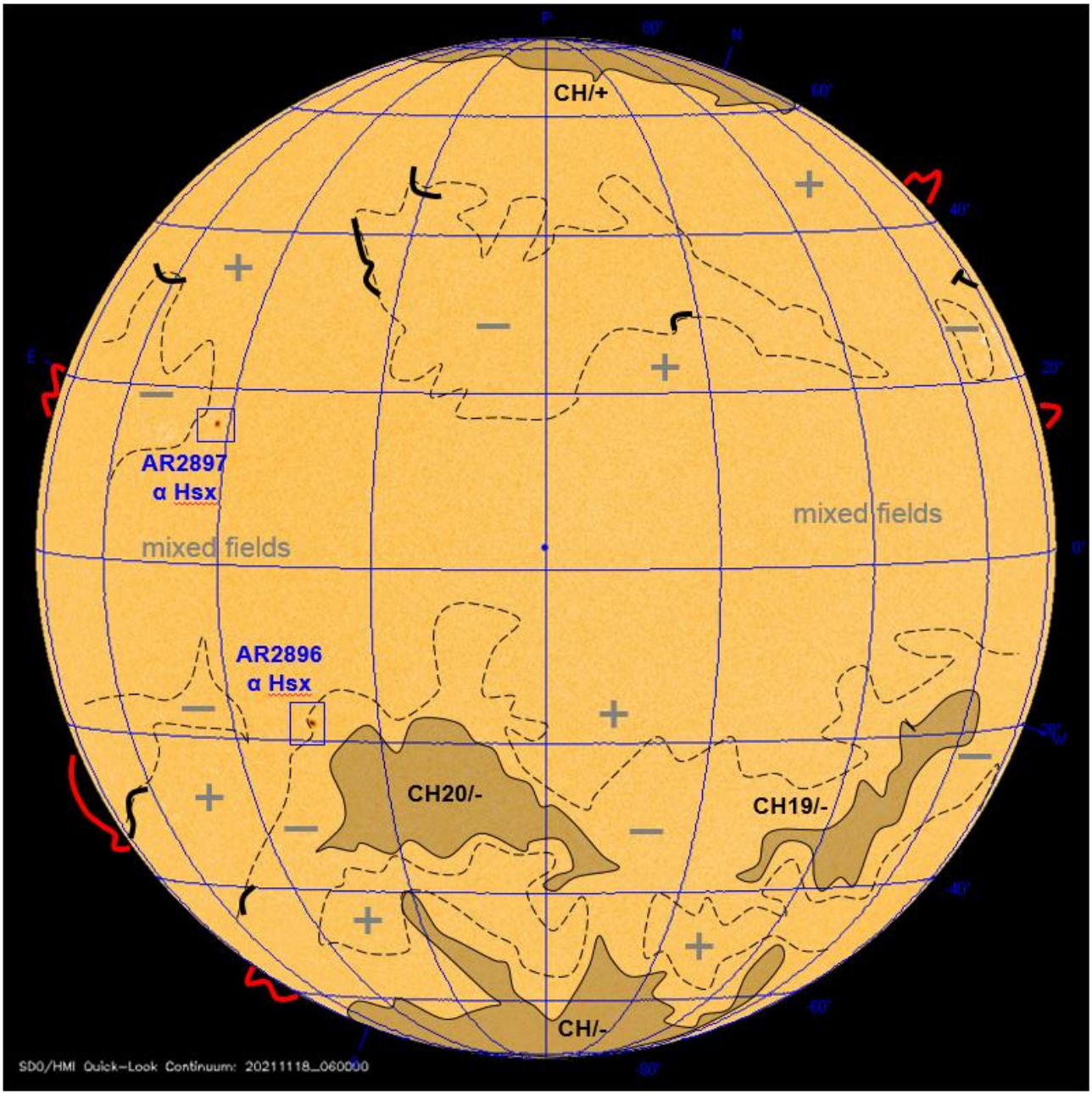
Figure 1. Solar Analysis Valid 18/0600UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs that feature in the current forecast.

The coronal hole forecast comprises two parts: firstly the current exit from coronal hole 19; and secondly the onset and magnitude of coronal hole 20.

The exit from coronal hole 19 is now well underway, with geomagnetic activity now very likely to have peaked with successive Active intervals near onset. There remains a Slight Chance of similar should the Bz component swing negative for a protracted amount of time while the speed is still elevated, although the IMF is now small and this is therefore not the favoured scenario - instead mainly Quiet conditions are most probable.

There should then follow a lull to end the working week UTC, with the duration of this the main uncertainty in the forecast. At present, owing to recent data from STEREO A, an onset within the UTC day of Saturday 20 November is thought most likely. This is a compromise between STEREO A measurements and Enlil, which favour an earlier onset (and form the stronger body of evidence);and then persistence and the apparent (significantly eastward) position of CH20 on the disc.

All considered, a strong peak in wind speeds in the region of 600-750km/s is possible, and therefore despite being near the semi-annual minimum in coronal hole potency, there remains a Chance of G1, probably peaking as the feature matures into Sunday 21 November.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	30	40
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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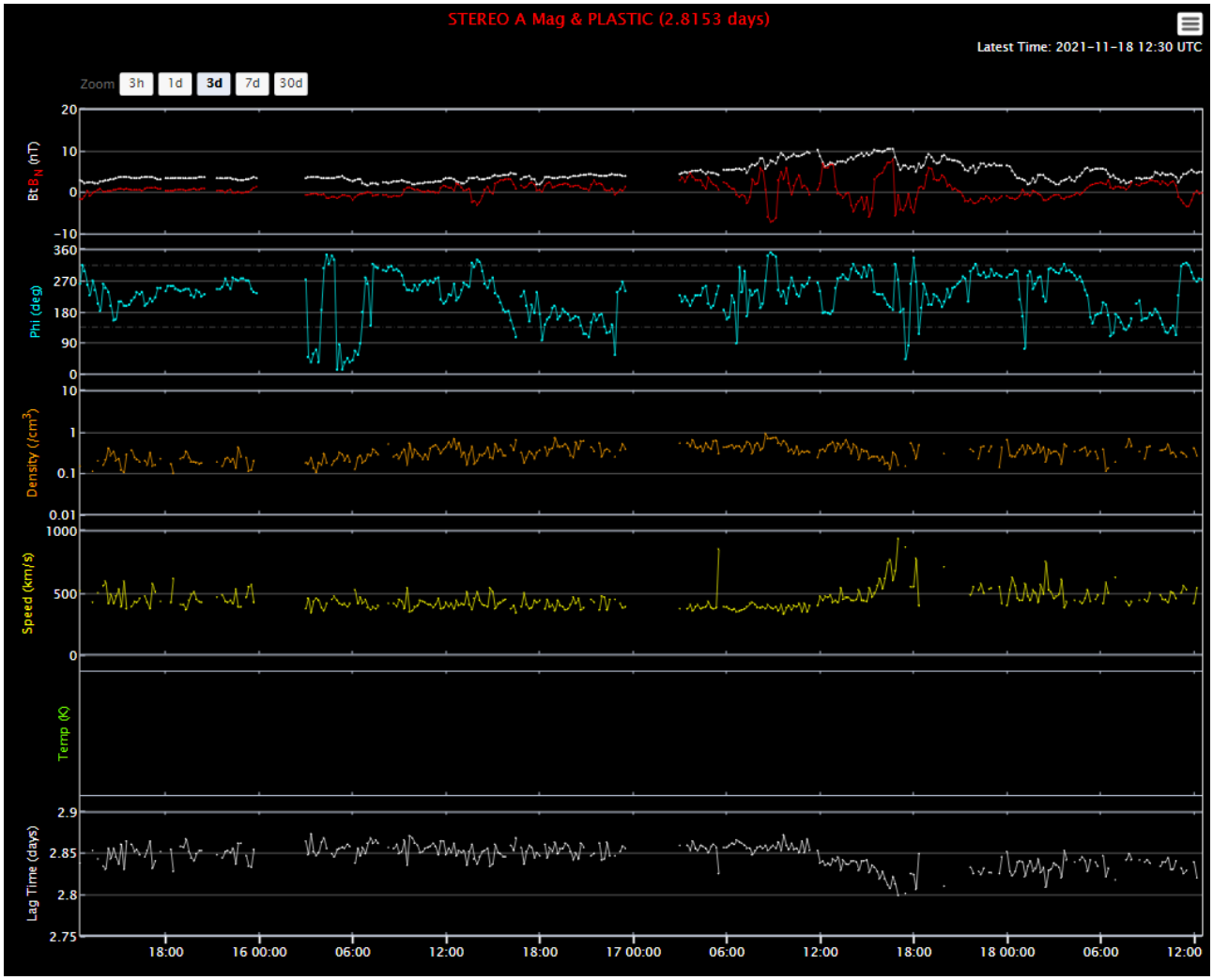
Figure 2: STEREO A PLASTIC measurements for past three days showing a disturbance due in just over 48 hours' time.



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Radio Blackouts - X-Ray Flares:

The current Earth-facing disc comprises just two stable unipolar spot groups: 2896 and 2897, which are both Hsx/Alpha groups with declining areal trends. neither of these groups has proven to be a significant progenitor of flares, and barring development, this is likely to remain the case into the coming UTC weekend.

No groups leave the Earth-facing side in the period, however there are numerous returning Carrington locations lying near or on the eastern limb at present. Despite this, STEREO A EUVI imagery does not hint at any major bright flux regions in the vicinity, and a flat trend in risk of significant flares is therefore proposed throughout.

X Ray Flares / Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at Background levels during the previous 24 hours, and is currently forecast to remain at this level through the period.

Radiation Storms / Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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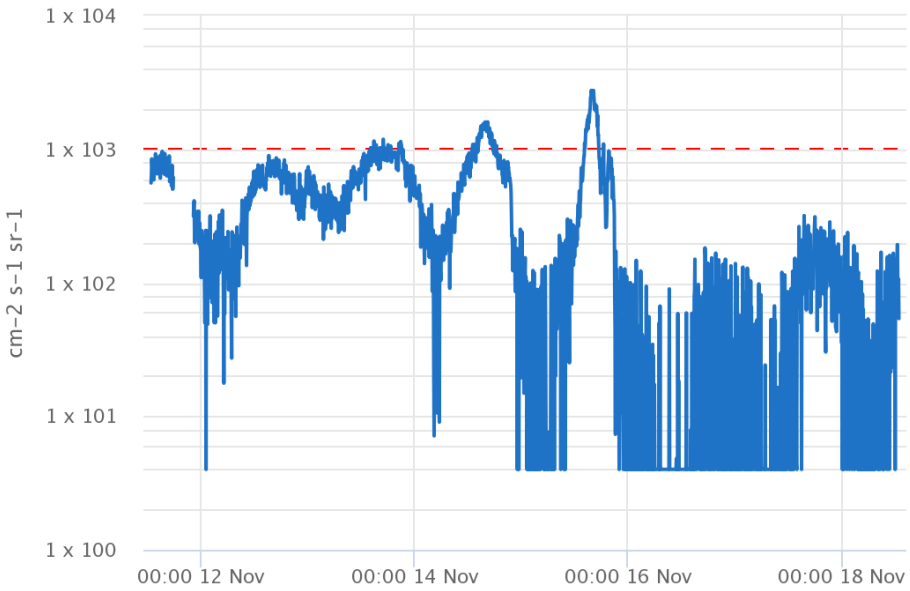
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as measured by GOES-16 is currently fluctuating between Normal Background and Moderate levels. During the remainder of day 1, a strong rise is anticipated in response to the recent elevated solar winds, with diurnal peaks likely to breach High levels during days 1-3 (18th-20th). Further apparent attenuation of electron counts is then likely for the second half of the UTC weekend, ahead of a probable return to Active fluence into the new working week as geomagnetic activity increases with the arrival of coronal hole 20.

The corresponding electron fluence is Likely to rise accordingly to round out the current UTC working week. There is some uncertainty in the expected magnitude of the response in fluence as a result, as the high speed stream from CH19 was both earlier and more intense than on last rotation, with its overall duration also expected to be around 24 hours longer. The effects on electrons now ought to be imminent, with the upward-trending signal in REFM perhaps overly damped and late, steered by the (much) less potent solar wind environment on last rotation.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	40	70	70	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	10	10	5

Figure 3: Past week in high energy electrons recorded at GOES 16. The current compression of the van Allen belt should reduce to the extent that increased electron populations show at GEO in the remaining hours of day one.



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